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Chemical warfare

Donald A. Cameron

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CHEMICAL WARFARE

by

Donald A. Cameron

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DONALD A. CAMERON *is a chemical expert who has made a study of the relation of the chemical industry to warfare.*

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CHEMICAL WARFARE

POISON GAS IN THE COMING WAR

I. THE COMING IMPERIALIST WAR

THE guns of the great "war to end war" have been silent only a dozen years, yet all signs point to the preparation of a new world conflict. The newspapers talk of it; war scares crop up; stories about "the next war" appear in books and magazines just as they did before 1914. But far more concrete than any of these surface indications is the tremendous growth of armies, navies and air fleets. Imperialist rivalries grow sharper every day. At the same time "peace" propaganda flourishes. Pacifist societies are active and pacifist books like *All Quiet on the Western Front* have a wide popularity in both Europe and America. Even statesmen talk peace, and "peace pacts" and "disarmament" conferences multiply.

In such an atmosphere how can war break out? To some it seems incredible, impossible. Yet in 1914 war got started under conditions not very different from to-day. Treaties that became scraps of paper were being written at The Hague; William Jennings Bryan, then American Secretary of State, was sponsoring peace pacts between several nations; and the Socialists of the Second International had agreed to fight any move toward war in their respective countries by means of a general strike. Within a week after the declaration of war, everything had changed. The reformist Socialists in all countries were busily voting war budgets and urging the workers to defend the capitalist "fatherland." When voluntary enlist-

ments failed to yield sufficient quotas of cannon fodder, the draft was resorted to. The world peace maneuvers showed their purpose—a smoke screen for a world war.

To assume, as Socialists and pacifists do, that war occurs because some nation or some wicked group of politicians *wants war* and moves aggressively against some peaceful neighbor, is a serious distortion of facts. War cannot be considered as an isolated event. It cannot be separated from the economic and political environment in which it matures. For world wars are not accidents; they are the culmination of struggles, domestic and foreign, constantly going on in the capitalist system. Modern capitalist imperialism is built on armed violence. It is based on the subjection of the working class at home, on the exploitation of colonies abroad, and on a continual struggle among the rival imperialist powers for foreign markets. Armed force is used to suppress strikes and workers' demonstrations in "democratic" countries like the United States and Germany, as well as in colonial countries like China or Venezuela. Indeed, as R. P. Dutt writes in the *Labour Monthly* (London), "Armed force is continuously active at one point or another of the system; now the suppression of a colonial revolt, now the massing of warships at a critical point, now a frontier war, now the subjugation of newly-conquered territory." (Witness the American occupation of Haiti, of Nicaragua, the French wars in Morocco, in Indo-China, or the present armed suppression of the Indian revolt by the "Socialist" government of England headed by the pacifist, J. Ramsay MacDonald.) "War and armaments are an inseparable accompaniment of imperialism."

Two Major Rivalries

To-day two new major rivalries have come to the fore. For a century the industrial, commercial and financial power of the United States has been expanding and strengthening. The war spurred on this growth, while it crippled Europe. The re-

sult is that with Germany at present out of the way, *the old British political empire and the young American economic empire are now facing each other and continually battling for world supremacy.*

Since 1917 an even more basic antagonism has grown up on the part of the imperialist powers led by England to the Soviet Union. For over a century Tsarist Russia had been England's great rival, particularly in Asia, and after the October Revolution England sought not only to destroy Bolshevism, but also to break up the Russian territory into such warring independent units that it could not be re-united even in case the old monarchists and bourgeoisie came back. The Revolution and the Red Army triumphed, however, and the vast territory from the Pacific to the Baltic Sea was again united under the dictatorship of the proletariat. To-day England and the Soviet Union stand at opposite poles economically, politically and culturally. England, still the world's financial center, represents the class domination of the financial and industrial capitalists and of the big landlords. England stands for capitalism with its declining anarchistic economy, its crises, its armies of unemployed, its hunger and misery for the workers. It stands for imperialism with its ruthless exploitation of the millions of workers and peasants in the colonies, and its vigorous suppression of movements for national independence. The Soviet Union, on the other hand, is the fatherland of the revolutionary workers of all the world, and an organizational center for national independence movements. It is run by and in the interests of the broadest masses of workers and peasants; it stands for socialism with its planned economy and scientific control both in industry and agriculture which is yielding such brilliant results under the famous Five-Year Plan; instead of the unemployment of the capitalist world the Soviet Union is decreasing hours, increasing wages, and maintaining a rising standard of living for the worker. The Soviet Union is wiping out illiteracy; it is waging a ceaseless battle of education against the stupor of religion

and superstition. It is promoting the equality of the workers of every race, color and creed.

Thus a constant struggle is going on between the forces of progress and the forces of reaction: between the capitalists and landlords, and the revolutionary workers and peasants: between the imperialist powers and the Soviet Union. To solve the internal crises of capitalism and to gain a vast new market for exploitation the imperialists are now seeking to destroy the Soviet Union. *This is the most important fact in international politics in the present era.*

Disarmament Smoke Screens

But what of all the disarmament conferences and peace treaties? They are nothing but the smoke screens behind which war preparations go on. Some means must be used to soften the glaring truth of increasing militarization. Conferences and treaties delude the population into believing that its statesmen are doing everything possible to prevent the coming conflict, and so the fake slogan of "defensive" war is cooked up and dished out at the proper moment. For modern wars require that mass support be obtained both at the front and behind the lines.

Even if "disarmament" conferences actually disarmed, it would mean nothing, for *in the modern world there could be war even if all war apparatus were abolished.* The great imperialist powers, all of which are highly industrialized countries, would be able to produce most of the munitions required in short order. For instance, the machine-manufacturing industries could quickly turn out tanks, machine-guns, rifles, etc. The great peacetime airplane industry could furnish speedy scout planes, air transports and heavy bombers.

Moreover, the chemical industry can never be disarmed, for its ordinary peacetime activities enable it to supply all the most important munitions and poison gases. It has become the backbone of modern warfare. How intimately its normal opera-

tions are connected with war is illustrated by a speech made by A. Cressy Morrison, a lobbyist for Union Carbide and Carbon Corp., before the Committee of Ways and Means of the U. S. House of Representatives on January 7, 1929. Arguing for an increased tariff on certain products made by his company, he said:

. . . It is a very interesting thing that the principal commodity now produced for peaceful uses is also a means of national defense of such extreme importance that no government can afford to be without this industry. . . . Take ethane as a base, treat it with chlorine, and we get certain invaluable chemical compounds for peaceful use, but which, with a twist of the wrist, can be changed into another of different potentialities but still safe. From another source comes another chemical equally safe. Both can be transported harmlessly to a battle front. Put the two together on the field of battle and you have mustard gas. Mustard gas is to-day treated by the war department of every nation as a basic war gas. Whether it is regarded as important or not in a peaceful country like our own, it certainly is becoming an absolute necessity abroad, and the diligence of the foreign governments in stimulating the production of these commodities is based upon the fact of national defense abroad. Whether that fact has any significance here or not is another question. I am simply stating the facts. . . .

An even clearer example of the military importance of the chemical industry, and of the steady preparation for the coming war which is going on under cover of peace treaties and disarmament conferences is shown by an article by Frank B. Gorin, former Chief of the Procurement Planning Division of the U. S. Army Chemical Warfare Service, which appeared in the *Oil, Paint and Drug Reporter* on March 15, 1926:

. . . Provided the War Department's carefully worked-out system holds up—and there is no apparent reason why it will not—the great industrial confusion which followed America's entry into the World War will not prevail again. . . . For several years the office of the Assistant Secretary of War has been busily engaged with the allocation of the facilities of the American chemical industry to the various branches of the military service where officers are struggling away to perfect detailed plans for the procurement of needed supplies in the next emergency.

According to the plans which are now fairly well completed, at the very hour, or possibly a few hours before, America next declares war, tersely worded official telegrams will automatically go forward from Washington to several hundred chemical plants scattered throughout the East and Middle West. In substance, the messages will say:—"Go ahead," and the innumerable war contracts which are being signed in these quiet times of peace will immediately become effective.

II. THE CHEMICAL INDUSTRY AND WAR

WHAT is this chemical industry that comes up in every discussion? What is this Supreme War Industry? To-day many people have a dim idea that airplanes and chemicals have become the chief war weapons even though the imperialist powers never mention them in "disarmament" conferences. Masses of people sense the importance of these weapons even without special training in Citizens' Military Training Camps, and even though they do not realize the close connection between the peacetime activities of the airplane and chemical industries and their use in war.

A Basic Industry

The chemical industry is one of the largest and most basic industries in the United States. The value of the products it makes each year is measured not in millions but in billions of dollars. Formerly, Germany ranked first in chemical production; whereas, now, America produces more than all the rest of the world put together! All industries are directly or indirectly dependent upon the chemical industry. Chemical products play an important part in such basic industries as iron and steel and in those producing aluminum, copper and other useful metals. Moreover, without chemicals, many familiar products would disappear: without bleaching agents and dyestuffs, the great textile industry would be placed in a very critical position and the paper industry would be crip-

pled; without sulphuric acid there would be no good gasoline and lubricating oils and the supply of fertilizers would dwindle; while without alkalies there would not even be soap or window glass.

In addition to being a basically important industry, the chemical industry is also a very large one. According to the classifications of the U. S. Census of Manufactures in 1925, it was the country's fourth largest industry, and was exceeded only by food, textiles and iron and steel, thus:

Industry	*Value of Products*	*Number of Workers*
1. Food and kindred products	$10,419,000,000	664,760
2. Textiles and their products	9,123,000,000	1,627,141
3. Iron and steel	6,462,000,000	851,270
4. Chemicals and allied products ...	6,438,000,000	381,075

These classifications are necessarily somewhat broad, but they show very definitely the size of the chemical industry in comparison with other industries that every one at once recognizes as of first class importance. And they show moreover that the chemical industry is large not only on the basis of output, but also as a *mass employer of labor.*

What is a chemical industry? How does it differ from the manufacture of a cotton fabric, or the production of an automobile body? In the spinning and weaving of cotton, the raw material is cotton and the final product is cotton, although in a changed *form;* an automobile body is made from steel and the final product differs from the raw material only in that it has been pressed and shaped and polished. The substance has not been changed, only its form. *In a chemical process the substance itself is changed.* Thus, by a process called nitration, ordinary cotton suitable for a textile mill is changed into nitrocellulose or gun-cotton. The latter is useless for making fabrics, but it serves excellently for hurling a high explosive shell. Or, for example, molasses may be fermented into alcohol. Either of these is a chemical process, and the final product is essentially different from the starting material. The scientific

principles and the manufacturing technique underlying all chemical processes are similar and thus serve to link together certain sub-industries that otherwise seem to be only remotely related if at all.

Composition of the "Chemical Industry"

In the broad classification used by the U. S. Census of Manufactures the "Chemicals and Allied Products" Industry is taken to include several products not actually made by chemical companies, such as soap, and manufactured gas. Thus, when any one speaks of the "chemical industry," the following industries are usually included:

Acids	Explosives
Alkalies	Drugs
Heavy Chemicals	Paints and varnish
Coal-tar products	Soap
Dyestuffs	Rayon
Organic solvents	Coke
Nitrogen products	Manufactured gas
Fertilizers	Petroleum refining

Every one of these industries is indispensable in ordinary times of peace. In the conduct of modern mechanized warfare they play a rôle of even greater importance, some of them becoming the *key* industries of war.

One of the most important chemical industries from a military point of view is the *explosives industry*. Many people have the false impression that this is exclusively a war industry, but such is not the case. The peacetime demand for explosives is enormous: the United States consumes about 500,000,000 pounds per year. Explosives are constantly required in coal and metal mining and in quarrying; they are needed in tunneling and railway construction and large quantities go into road building, irrigation work, stump blasting and land drainage. Like many other industries, the explosives industry found itself over-expanded at the close of the last

world war. One of the results of this over-capacity was the development of the modern duco-type (nitrocellulose) automobile lacquers through the efforts of the explosives manufacturers to find new uses for their partly idle plants.

Should war be declared to-morrow, the explosives industry would be able to proceed at once with the manufacture of war munitions. Specifications for the manufacture of Government explosives have been written. The Army knows the location and the capacity of every plant in the country. Plans have been laid to assure a proper supply of raw materials. Close relations between the military authorities and the technical and operating staffs of the various factories have been maintained. Charges for huge airplane bombs, for torpedoes, for mines, for artillery shell and shrapnel, for rifle bullets and hand grenades can be turned out as soon as the order to go ahead is received. And all this can be carried out with practically no expansion of existing plants and only minor changes of equipment.

Another chemical industry which has long contributed to success in warfare is the *drug industry*. One of the greatest needs is for disinfectants when masses of men are uprooted and forced to live under primitive conditions in territory without adequate water supply, without plumbing facilities, and when open wounds are of daily occurrence. The drug industry supplies the anesthetics that ease the pain of operations, the antiseptics, the opiates, the cathartics and all other familiar medicines. The terrible results of lack of drugs were evident in Soviet Russia, 1920-1921, when, after years of imperialist and civil war, the supply was exhausted and soldiers at the front and the people at home died by thousands for lack of even the simplest medical treatment. The Allied blockade cut off the imports of necessary medical supplies and was directly responsible for the deaths of thousands of Russian workers and peasants.

Explosives and drugs have been the major contributions of the chemical industry in past wars. But the great Imperialist

War of 1914-1918 saw the development of two new chemical industries of even greater importance. One of these is the nitrogen industry, and the other, the poison gas or chemical warfare industry.

The Struggle for Nitrogen

The *nitrogen industry* is one of the most fundamental in all chemistry. It supplies an absolutely essential raw material. Without an adequate supply of nitrogen, the explosives industry simply could not exist, for nitrogen is the most essential constituent of all explosives. Up until 1914 the entire world's supply of nitrogen-containing chemicals came from Chile in South America, where vast beds of Chile nitrate exist. This chemical was mined and purified and then shipped to all the industrial countries where it was made into explosives and other chemicals, and also used directly on the soil as a fertilizer.

Germany realized very clearly the strategic importance of this fact; so when war was declared, some German passenger ships off the coast of Chile were armed, and for several months succeeded in preventing any supplies of nitrate from being sent to Great Britain. British supplies were rapidly reduced to the vanishing point by the tremendous demand for explosives manufacture and the situation became desperate. But just about this time, British warships succeeded in capturing the German ships and the flow of nitrate toward England was again re-established. Meanwhile, England had learned her lesson and in turn blocked the shipments of nitrate to Germany. Under these conditions Germany was inevitably doomed to defeat as soon as her nitrate stores were consumed, unless she could supply herself with nitrogen from some source within her own frontiers.

The chemists and the chemical industry came to the rescue. There is no source of nitrogen in the German soil as there is in Chile, but there are thousands and thousands of tons of

nitrogen *over* every square mile of land, for the air we breathe consists of a mixture of four parts of nitrogen to one part of oxygen. This fact had been known for a long time, but great difficulties were encountered in combining the nitrogen in such a way that it could be used in industry. The crisis in Germany led to a concentration of effort on this problem, and it was brilliantly solved by Professor Haber. By means of his synthetic process, Germany succeeded in making all the nitrogen products she needed for the four long years of the war.

At the close of the war in 1918 every power, big and little, began a race to install plants that could produce nitrogen by various modifications of the method that had proved so successful for the Germans. *In other words, the ink was not yet dry on the Treaty of Versailles when the chemical industries of all countries began preparations for the next war!* Some plants were set up in locations totally unsuitable from the viewpoint of capitalist profits and could only run on the basis of Government subsidies. For instance, Italy, Jugoslavia and Japan all have large installations, yet all are lacking in the most essential requisite—cheap fuel. Therefore, in times of peace they can buy nitrogen on the world market cheaper than they can possibly make it themselves. The imperialist powers, Great Britain, the United States and France have been particularly active in developing independent nitrogen industries. Competition on the international market has brought the price so low that the Chilean industry has been badly crippled; some of the world's synthetic plants have been standing idle while many others have been running at reduced capacity for years. But they are all ready to operate at a moment's notice. And building still continues.

The feverish pace with which this industry has grown; the complete disregard of all the rules of capitalist economics which has led to over-expansion and low profits even in such a new industry; and the close connection between the various producing companies and their governments as shown by subsidies, tariff policies and scientific coöperation; all indicate

clearly the steady preparations for war. Sometimes the capitalists themselves, in an unguarded moment, admit this. For instance, W. S. Landis, vice-president of the American Cyanamid Company (one of the leading American chemical companies which is interested in nitrogen) wrote recently:

> The relationship of supply and demand has no consideration in many of the new construction programs. The relationship of selling price to cost of production has nothing to do with the operation of certain of the plants. *Military preparedness is a formula that overcomes such little obstacles and a trained operating crew in a proven plant is considered far more important than a profit or a dividend.*

But however important nitrogen, explosives or drugs may be, the great modern contribution of chemistry to warfare is *poison gas*. Poison gas is just an inaccurate and popular name for a group of many different substances, some gases, some liquids, and some solids that have harmful effects on human beings.

Unlike most military weapons such as cruisers, submarines and artillery that have no peacetime uses and hence must be made long in advance and held in readiness for war, most poison gases tend to decompose and spoil if kept for long periods. But there is no need to keep them: all raw materials from which they are made and almost all of the apparatus required are *essential parts of the peacetime chemical industry!* And the time required for manufacture is negligible.

Chemistry has always been in a position to furnish harmful compounds of one kind or another, but only in the last war had technique developed to such a point that they could be used effectively on a mass scale. Furthermore, the last war was the first imperialist war between modern first-class industrial powers and the struggle was so desperate that any weapon was "fair." Gas had been outlawed at international conferences of the big powers before 1914, but when the need for it arose, all the countries considered the treaties as scraps of paper. As for the future, previous history has shown that when an important new weapon is developed, no amount of

treaty-making or clap-trap about its inhumanity is sufficient to prevent its being used when the need arises. At present, as we have seen, there is a great deal of talk about "disarmament" and a few old and worn-out battleships are being scrapped, but the perfection of chemical warfare proceeds at an unprecedented pace.

III. GAS VERSUS GUNS. THE NEW WEAPON

The Purpose and Technique of Warfare

It is a popular misconception that war is a mere matter of brute force. War is a highly organized technique for imposing one's will on the enemy. To be sure, force is the ultimate arbiter. In the nineteenth century military strategy—the art of using force—became a science, and since then in all countries men have devoted their lives to a study of the great battles of the past, to methods of organization and combat and supply, and all the technique of modern science and industry has been drawn upon.

An old rule of strategy says that it is necessary "to have at the decisive point at the decisive moment a more effective force than that of the enemy." Another one insists that if you want to win you must seize the initiative, and thus by depriving the enemy of his free choice of time and place, make him fight on your terms. Passive resistance gets nowhere. Lenin understood these principles very well when he said that in a strike or in an uprising it is essential to win a first success, and then day by day, sometimes even from hour to hour in critical times, it is necessary to win some victory, however small. Surprise remains the most important element in strategy.

What are the "decisive points" in modern mechanized warfare? When several million men are uprooted from their daily life and flung on the battlefield, the burden of feeding, clothing and sheltering them, to say nothing of supplying them with

weapons and ammunition, is enormous. Thus the enemy's jugular vein is the railroad and motor roads, or the railroads and ships that lead back to his base of supplies. In trench fighting the immediate objective may be a hill, a village at a cross-roads, a bridge, etc., but the chief decisive points are railroads, important cross-roads, hills, ports; and behind the lines railroad centers (Paris, Cologne, Moscow, New York, Chicago), ammunition dumps, and all large industrial towns where basic industry is carried on and munitions are made.

Thus the object of war is not just to go on killing until one side gets tired of it, but rather to seek out these "nerve centers" of the enemy, and by attacking them to paralyze him.

The New Weapon

Old-fashioned war might be said to be a war of blows. An adversary was subdued by being *hit* with a club, a tomahawk, a sword, a cannon ball, a rifle bullet, or shrapnel. The invention of gunpowder and other explosives was a revolutionary development in that it furnished man with forces far more powerful and concentrated than his own muscles. The use of explosives was practically entirely confined, however, to bullets and projectiles the ultimate object of which was merely to *hit* the enemy.

The introduction of poison gas marks a far more important revolution in warfare than even the invention of gunpowder. For chemical warfare seeks man's Achilles' heel—his tenderest and least protected parts. As new gases were introduced first his lungs were attacked, then his eyes, then his nose and throat, and finally his skin. Gas can kill—silently, swiftly, surely. It can disable men and cause horrible wounds that take months to heal. Or it can cause torture and anguish lasting for a few hours or minutes. Old methods of military defense are useless against gas. Aside from all these advantages that gas has over older weapons, there is still another: the psychological effect of gas warfare. Since most gases are invisible

at concentrations at which they are dangerous, and since some are odorless, the soldier is constantly exposed to "unseen death." He may save himself from bullets and shrapnel and grenades by diving into a trench or shell-hole when he hears them coming. Gas sneaks upon him unawares. Even now the best of protection is clumsy and uncomfortable, and so the effect of gas in quickly breaking down morale is greater than that of any other weapon. Old-fashioned army officers thought the only way to win a war was to *kill* the enemy. Experience has shown that it is more effective, for instance, to burn one's opponent with mustard gas. This not only removes him from active service for from one to six months, but requires elaborate hospital care behind the lines, thus further embarrassing the enemy. A corpse need only be buried.

The Major Poison Gases

Poison gases are in the main organic chemicals that are particularly effective in damaging the human body. Of all the thousands of these organic compounds that have been studied in the world's laboratories for several generations, only about 28 were actually used in the World War, plus about 16 mixtures of these gases. Actually the number of "gases" which are really effective and which can be produced and used on a large scale is much smaller than that. It is important to bear this in mind when reading the scare stories that circulate from time to time about the discovery of a new gas so powerful that "X drops will wipe out an army."

On the whole, then, despite the fact that the highly trained chemists are making great efforts to develop new gases, it is practically certain that in the coming war the gases that will be used will be principally those that were tried and proved in the last war. We may now describe some of the most important of these gases.

All gases may be classified roughly into groups on the basis of what they do to human beings, thus: 1. Gases that kill

(lethal gases). 2. Tear gases (lachrymators). 3. Sneezing and vomiting gases (sternutators). 4. Gases that burn the skin (vesicants). Often it is very difficult to draw the line, for the properties of all gases overlap somewhat; thus a gas may be both sternutatory and vesicant, or lachrymatory and lethal.

Gases That Kill (Lethal Gases)

Lethal gases are designed to do just what their name implies—to kill. They are drawn into the lungs and act both by direct poisoning and by causing intense pulmonary congestion and asphyxiation.

Chlorine, a greenish yellow gas familiar to workers in textile bleacheries, laundries and paper mills, was used by the Germans in the famous first gas attack in 1915. When more deadly gases were developed, chlorine was discarded but it is still very important as a raw material in the manufacture of other gases. *Phosgene,* produced from chlorine and carbon monoxide, can kill quickly, but in low concentrations it has the important property known as *delayed effect.* During the war phosgene was used not only in projectors, but also in large quantities in shell. *Super-palite,* or diphosgene, is more persistent than phosgene, and does not evaporate at once. The Germans used large quantities of this gas during the war.

Tear Gases (Lachrymators)

Tear gases cause intense pain in the eyes but are not poisonous in the concentrations necessary to produce blinding tears. Indeed, should you walk into a room containing only enough to go on the head of a pin, you would feel as though some one were tearing your eyes out with his finger nails. Yet if you run out immediately, in fifteen or twenty minutes you are quite all right again.

Workers are particularly interested these days in tear gas, because the police and the corporations who control the police

have taken up this new weapon, using it to break up meetings, picket lines and demonstrations. During the first part of the war, gas-tight goggles were used by the soldiers to protect themselves from these gases. Later the ordinary gas mask was sufficient. The great value of tear gases is against unprotected troops (or workers), or in causing troops to work in uncomfortable gas masks for long periods of time. They are very "economical" because a few shells are sufficient to harass large numbers of people.

The tear gas *brom-benzyl cyanide* is so powerful that only 2 parts in 10 million are necessary to cause sufficient pain to make it impossible to open the eyes. It can maintain its effectiveness over periods of time as great as 30 days. *Chlor-aceto-phenone,* another tear gas, is the police favorite. It has been widely adopted by the American police, various sections of the national guard, the militia and other strike-breaking organizations. This gas is shot from a pistol or set off from a special burning hand grenade which burns for about five minutes and has an immediate effect. After doing its work it quickly disappears.

Sneezing and Vomiting Gases (Sternutators)

This class of compounds was used to produce sneezing and vomiting so that the gas mask had to be taken off, and then some much more poisonous gas finished off the victim. These gases cause intense pain and irritation of the nose, throat and respiratory channels. They are mostly arsenic compounds, and are not only sternutatory, but also toxic, producing the after-effects of arsenic poisoning.

Di-phenyl-chloro-arsine is the most important of the arsenic-containing gases. In low concentrations of one part in 10 million it causes sneezing and in higher concentrations causes severe vomiting. Other sternutators used during the war include *adamsite* and *chloro-picrin,* both effective in causing men to remove their masks in the presence of more deadly gases.

Gases That Burn the Skin (Vesicants)

Chemicals for use against the skin are called vesicants. The skin was the last sensitive part to be attacked, but the ability to attack it has presented more advantages and problems than all the other chemicals combined. Man's lungs and eyes, nose and throat could be protected by a good gas mask. How could his skin be protected? There are two gases in this class, but only one of them—*mustard gas*—is important. The other, *Lewisite,* has not been actually used as yet in warfare, though General Fries, suggesting its use in airplane bombs, called it "The Dew of Death."

Mustard gas did not appear until late in the war, when the Germans introduced it at Ypres in July, 1917. It was then, and it remains to-day, "The King of Gases." Only the commonest every-day chemical raw materials, namely alcohol (for ethylene), sulphur and chlorine are required to make it. This gas is effective in low concentrations, has very little odor, and the victim has no immediate sign of discomfort. It remains on the ground and in low places for days, and causes huge casualties.

The chief property of this gas is its ability to cause severe blistering and burning of the skin, even through clothing, in either the vapor or the liquid form. As little as one part in 14 million is capable of causing severe inflammation of the eye, while one part in 3 million and possibly one part in 5 million will cause a skin burn in a sensitive person on long exposure. Horses and dogs which are used in warfare are also harmed by the gas. It even corrodes machinery.

In man the mustard gas penetrates the cells of the skin, and is then hydrolyzed by the water in the cell to hydrochloric (muriatic) acid, which causes intense irritation and the formation of deep and painful blisters. These wounds heal very slowly. The lightest burns require several weeks to heal, while serious ones last for months. Wherever there is moisture from

perspiration, as under the arm-pits and in the crotch, mustard gas attacks more easily. Yet despite its terrible severity, mustard gas has considerable *delay action.* It has no immediate effect on the eyes or throat, but a few hours afterward the victim will be absolutely blind for a period of many weeks. Because of this delay action and because it is effective at concentrations that cannot be detected, mustard gas is the most effective of all gases in breaking down morale.

In addition to its burning properties, mustard gas is one of the most poisonous of all war gases. In the next war its terribly toxic effects will be more fully utilized by placing a large charge of high explosive in the shell which will spread it about as a very fine spray. Thus the victim will draw into his lungs in one or two breaths enough to kill him. This type of shell was very effectively used by the Germans in the last months of the war.

IV. POISON GAS STRATEGY AND TACTICS

Firing Gas at the Enemy

It is not enough merely to have a large supply of the deadly gases described above. The gases themselves would be useless without means of discharging them at the enemy under controlled conditions.

The *Stokes mortar* has become the principal weapon of the chemical troops in trench warfare. Gas may also be discharged by means of *hand and rifle grenades* and *smoke candles.* All these means deliver only small quantities of gas, and are only effective in close fighting, or in attacking crowds of workers.

From the standpoint of the number of shell fired, the *artillery* ranks supreme, and in any war there will be wide application for artillery fire with chemical shell. Big guns are effective over large distances, the 155 millimeter gun firing accurately at a point even 10 miles away.

Airplanes and poison gas will be the most important weapons of the next war. Just as gas may be placed in artillery shell, so may it be put into *airplane bombs*. Airplanes can now carry all types of bombs from the ½ pound incendiary to the 4,000 pound destructive type. Probably more effective even than airplane bombs, however, will be the *sprinkling of gas from airplanes* (particularly mustard). Major C. R. Crockett stated in *Chemical Warfare* for November 15, 1929:

> The demonstration recently given at Edgewood Arsenal by the Chemical Warfare School of the release of chemicals from airplanes by the spraying method seems to afford conclusive evidence of the practicability of utilizing such devices. . . . Apparently chemical science is unable to offer satisfactory protection against this new measure and the sole counter measure appears to be of a military nature, *i.e.*, the development of such pronounced air superiority that the hostile aircraft will be unable to leave the ground.

Defense Against Gas

The use of gas in warfare presented an entirely new military problem. Mass protection, such as was formerly afforded by forts, trenches, dug-outs, etc., was not enough: each *individual* had to be protected. Simple gas masks were soon introduced and by 1916 work had begun on the "Box Respirator," which is the same type as that used to-day. Such masks when properly adjusted were thorough protection for the eyes, nose and throat, and lungs, and so were satisfactory against all types of gas except the vesicants—the skin burners.

But even the best gas mask is uncomfortable. There is some resistance to breathing—as though some one were holding a handkerchief over your nose and mouth—and the air is so thoroughly dried by the chemicals that the nose and throat get sore after a while. When the soldier does hard work, the mask gets very hot and stuffy. After being exposed to gas for long periods at a stretch, soldiers occasionally tore off their masks and said they would rather face the gas and get it over with than endure the endless discomfort of the mask! In fact,

it is now a part of regular tactics to send over a smoke cloud with just enough tear gas in it to force the wearing of the mask, and thus harass the enemy and wear down his resistance.

Protection Against Mustard

Even good gas masks do not protect one's skin against the vesicants, like mustard gas. Mustard gas in the vapor form is practically odorless and invisible. *It penetrates all ordinary clothing.* Even in the liquid form, it acts very slowly. The writer knows of an ambulance driver who drove several kilometers while sitting in a puddle of it, thinking that it was merely rain that had fallen while he was collecting the wounded! Despite its *delay action,* its after-effects are sure and terrible. Indeed it is so effective in producing casualties that the gas research laboratories of all countries worked steadily during the war, and have been working ever since, trying to develop adequate defense against it. But even to-day there is no satisfactory defense against mustard. It remains the King of Gases.

Gas-proof Dug-outs

Soldiers cannot wear gas masks all the time: they must eat and rest and sleep. Thus it becomes necessary to develop some kind of gas-proof room. Outside the air is likely to be filled with poisons of all kinds; inside it must be pure. Provision must be made against gas filtering in through cracks and crannies. It must be possible for soldiers to enter and leave without letting gas in. This has been achieved somewhat as follows: a dug-out is constructed as air tight as possible. It has a special air-lock instead of a door (on the principle of a canal lock). Air is supplied by means of a hand or motor-driven blower, which first sucks it through a purifying device like a giant gas mask and then delivers it under slight pressure to the dug-out. The pressure in the dug-out will always be

slightly higher than outdoors, and so air will tend to leak out of rather than into the structure. But there is always a danger of leaks, or of a soldier bringing in mustard gas on his uniform quite unaware.

Strategy at the Front

The tactical importance of gas cannot be exaggerated.

1. It goes around all obstacles and sneaks through tiny cracks. (Sandbags or trenches will protect against rifle bullets, but not against gas.)

2. It is effective in very small quantities.

3. Due to the *delay action* of certain types of gas (*e.g.* phosgene, mustard gas), troops occasionally fight unawares in low concentrations and become casualties later.

4. It is *persistent.* (High explosive shells burst and disappear.) The fact that some gases are much more persistent than others makes them strategically important.

5. Exposure to unseen death at all times of day or night wears down the morale of the hardiest and best trained troops. All drinking water and food near the lines is in danger of contamination.

The commanding officer is able to choose just what gas or gases he wants to achieve a particular objective. For instance, a non-persistent lethal gas, like phosgene, is sent over just before an attack is made. The gas harms the enemy, but evaporates before the attacking troops get there. Sneezing gas is sent over together with a lethal gas: the former may catch the soldier before he can get his mask on, or may leak through around the edge of the mask if he has not shaved, and make him sneeze and vomit. Meanwhile the lethal gas kills him. Tear gases are used in all sorts of combinations to force wearing of the mask, and break down efficiency and morale.

But it is mustard gas that has made possible the new strategy because it offers a *new type of obstacle.* Obstacles

have always been important in war, whether barricades, forts, rivers or other natural or man-made barriers. Mustard offers a new method of blocking out an area so as to prevent its use for military defense or for communications. A normal flat piece of countryside can be made as impassable without serious casualties as a mountain or a river well-manned by rifles and machine guns. It only needs to be drenched with mustard gas. Thus the flanks of an army can be protected from attack by spraying the territory with mustard. Strong points that could only be stormed with tremendous loss of life can be taken with mustard, even if they cannot be occupied by the victors immediately.

Smoke Strategy and Incendiary Agents

Another strategically important weapon of chemical warfare is the smoke screen. Various chemicals, such as silicon chloride, titanium chloride, or phosphorus can be used to produce dense white smoke of great hiding power. Smoke screens are usually laid by airplanes. Smoke may be used to blind known enemy observation posts or machine gun nests, but its most important uses are in shielding and hiding the activities of one's own forces. Or it may be sent over the enemy lines mixed with a little tear gas as a harassing agent to imitate a real gas attack. But in general the major advantage of smoke screens is that they permit secrecy in carrying out operations during the daytime that formerly could only be done under cover of night.

One of the very best smoke producers is white phosphorus which forms the thickest and densest cloud. In addition, phosphorus bombs are excellent incendiary agents, and any inflammable object they hit will catch fire, for phosphorus burns as soon as it comes into contact with the air, whether wet or dry. Water will not put it out. Phosphorus bombs may also be used against troops, and Shiver, writing in the *Journal of Chemical Education* in February, 1930, says:

. . . white phosphorus has a most excellent harassing and morale lowering effect. . . . The explosion of a phosphorus bomb, scattering lumps of burning phosphorus over a wide area has a most terrifying aspect, and may lead to serious burns since it continues to burn as long as oxygen is available, even when embedded in the flesh.

Mr. Shiver is right: phosphorus burns are among the most terrible of all chemical wounds, and the hardest to heal.

Strategy Against Cities Behind the Lines

A country is not really conquered until its strategic centers are actually occupied by the invading forces. Therefore, the chief purpose of bombarding large centers of population is to hamper their military and economic work and to wear down their morale. In the coming war, poison gas will add to the horror of living in the large centers. Shrieking sirens at midday or in the dead of night will announce the arrival of enemy airplanes to scatter tear gas, or vomiting gas, both of which are effective in concentrations of only a few parts per million. Fires will be started by phosphorus bombs. Sometimes all the central areas will be drenched with mustard and in spite of every effort to destroy the gas, those who are not killed will be exposed to the danger of awful burns for days afterwards. Main highways, railroad yards, factory districts, army cantonments—all will be sprayed and bombed with mustard.

In regard to the protection of the civilian population, a dispatch to the New York *Times* about three years ago stated that the house committees in Leningrad had been ordered to see that every one is provided with a gas mask and that special gas-proof cellars be constructed large enough to accommodate all the people living in the house. This is a good example of the foresight of the first Workers' Government. They know that the imperialist governments are trying to line up a capitalist united front against the Soviet Union, and that the attack may come at any time now. Consequently, every effort

is made to train and protect not only the soldiers of the Red Army, *but also the industrial workers in the great cities.* For the Russian workers' leaders know that the next war will be a war of chemicals, airplanes and tanks. And they know that capitalist talk of "disarmament" is merely a smoke screen for further war preparations.

Poison Gas Against the Workers

Workers all over the world have begun to feel the effects of poison gas in their struggles with their bosses, but nowhere more than in the United States. Here every one from the New York City police to the hired thugs and strike-breakers of the big companies is equipped with and uses tear gas when he comes into conflict with the working class. Yet the writer of an unsigned article in *Chemical Warfare,* January 15, 1930, said:

> . . . Tear gas is too powerful an agent to use except in rare cases, although it produces nothing more than physical discomfiture for a short time. Smoke is the most desirable agent to use, and of the various smokes white phosphorus should be eliminated. Smoke places a blanket over a crowd and reduces it to a group of individuals of which each member is separated from his neighbor. The mob spirit is thus greatly broken up, for though the crowd may all have the same purpose in mind, each individual loses to a certain extent the feeling that the crowd is backing him. . . . The leaders of the mob cannot be seen and their influence exerted upon the members.

In another issue of the same journal a young officer describes his experience in the Boston police strike, and says that *white phosphorus* bombs would have been very effective in restoring "law and order!" He recommends the use of white phosphorus against the Chinese workers in their strikes and political demonstrations against the imperialists.

V. THE WORKERS AND THE WAR DANGER

THE enemy of the working class is not war, but the capitalist system that is fast breeding another war. That imperialist

war is a function of capitalism the workers in all countries are beginning to see. Naval conferences, "consultative pacts," discussions of "security," all indicate in their several ways the preparations for another world slaughter. Whether this will be a war between the rival capitalist powers, or whether they will be able to smooth over their antagonisms for a while and unite in a joint war on the Soviet Union it is impossible yet to predict. But that the situation is more menacing to-day than it has been at any time since the last World War is admitted even by many pacifists. The workers are gradually beginning to see behind the smoke screens of "peace" talk and "friendship" gestures. The "unthinkable war" is rapidly approaching.

Rival Combines

As a part of the preparation for this new war the chemical industry, as we see here, plays a key part. International competition in chemicals grows increasingly sharp. In 1926 all the leading British chemical companies were merged in the Imperial Chemical Industries. Its purpose was to meet American and German competition in all parts of the world. Its formation was a direct step toward war.

Groups of American bankers and industrialists, however, are interested in both the big British and German chemical combines. So that to-day, as Ludwell Denny writes in *America Conquers Britain,* "there are thus beginning to form two great opposing international capital groups, American-British and American-German." And the pro-British financial group is doing all in its power "to prevent that growing American-German financial alliance which may be eventually a determining factor in the conflict between America and Britain for world supremacy."

This international competition can have but one result—a stiff battle for lower prices, increased pressure on the workers' conditions making them worse in all countries, and in the end

the transformation of the economic struggle into armed conflict between the powers.

Chemical Concentration

And as the American worker surveys the chemical industry of the United States what does he see? He sees that it has been consolidated into tremendous horizontal and vertical combinations. Over 75% of the present production is concentrated in the hands of 8 corporations. And three giant firms stand out as the premier money makers of the industry —Allied Chemical and Dye Corp., E. I. DuPont de Nemours & Co., and Union Carbide and Carbon Corp. These three have 60% of the total assets of all the chemical companies in the country. Allied Chemical and Dye calls itself the greatest chemical company in the world.

All of these companies have been steadily increasing their enormous profits, while the smaller companies have shown more "irregular" profit records. The tendency, as in all industry, is for the big companies to squeeze out the smaller ones. Eventually the workers, just as in the electrical manufacturing industry, will find themselves exploited by but two or three outstanding companies. The process known as "rationalization" is being pushed to its extreme in the chemical industry, with the usual effects on the workers.

The Workers and Their Jobs

These workers in the chemical and allied industries number nearly 400,000. In spite of the great concentration of financial control in the industry, they are widely scattered in some 8,900 separate establishments, making an average of about 45 in a plant as compared with over 130 per plant in the iron and steel industry. The average worker is unskilled, although a small number are highly technical workers. Unemployment plagues the workers as in all capitalist industry, no matter

how "efficiently" operated from the viewpoint of profits. Health and accident hazards are serious in most plants. Explosions frequently occur in certain types of plants, often killing dozens of workers.

Wages of these workers, including the highly skilled ones, averaged a little over $27 a week in 1927. Yet the employers keep on shouting for a higher and higher tariff to "protect" labor. The percentage of labor cost in relation to the value of the products turned out by the industry is one of the lowest to be found in this country. In the iron and steel industry labor cost is approximately 20% of the value of the product. In the chemical industry it is only 8%.

It is well to contrast the situation of the workers in this American industry with that of the 270,000 workers in the same industry in the Soviet Union. In the United States they are entirely unorganized, unable to fight in an organized way for wages, social insurance, unemployment relief and better safety conditions. In the Soviet Union, on the other hand, they are over 95% organized in a powerful union that speaks for the workers in all negotiations with the government trusts. And many of the workers there are already on the seven-hour day as compared with the ten-hour day and much overtime in rush periods in the chemical plants of America.

In the Soviet Union also the chemical industry serves the will of all the workers of the country and is hailed as a potent force for industrial progress under the Five-Year Plan. It is regarded as an essential weapon for the protection of the workers' government against the war offensives of the capitalist states. A popular voluntary organization called the *Osoaviakhim* (Society for the Promotion of Aviation and Chemistry) already has some 50,000 locals and 4,000,000 members in all parts of the workers' republic. It is interested in the advance of these two industries as the most effective means of defending the achievements of the Revolution.

But the workers in the American industry remain scattered

and unorganized. The American Federation of Labor has done nothing to organize them.

The Need for Union

In attempting to turn the world imperialist war into a civil war against the capitalist class, the mobilization of all the workers in the key industries is a vital necessity. This involves a closer understanding between the free chemical workers of the Soviet Union and the exploited workers of the United States. It calls also for an organized alliance between the chemical workers of the United States and the American steel, automobile and aircraft workers employed by the same overlords who dominate the chemical industry. It demands a linking up of all the American chemical workers under militant leadership and in an organization pledged to fight aggressively against war and the capitalist system that produces war. The militant trade union movement in this country, which is led by the Trade Union Unity League, aims to unite all the chemical workers into one industrial organization. By supporting such a union workers in every industry will be helping to fight the growing danger of war.

THE END